

# EXHIBIT 4

(Claims Chart U.S. Patent 11,435,018)

# Patent Infringement Review of Faster Coupling

## US Patent 11,435,018



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(12) **United States Patent**  
**Foner**

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(45) **Date of Patent:** **Sep. 6, 2022**

(54) **HYDRAULIC MULTI-COUPLING WITH INDEPENDENT SINGLE HANDLE ROTATIONAL DISCONNECT**

(58) **Field of Classification Search**  
CPC ..... F16L 37/002; F16L 37/56; A01B 76/00; A01B 59/043; 102F 9/2275; 102F 3/3654  
See application file for complete search history.

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 128 days.

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§ 371 (c)(1),  
(2) Date: **Sep. 9, 2020**

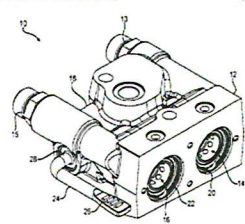
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PCT Pub. Date: **Nov. 21, 2019**

(65) **Prior Publication Data**  
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EP 624490 A2 \* 10/1994 102F 3/3654  
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Primary Examiner — James M Hewitt, II  
(74) Attorney, Agent, or Firm — Reimer, Otto, Boisselle & Sklar, LLP

(57) **ABSTRACT**  
A multi-coupling assembly includes a first female coupler and a second female coupler whereby the female couplers are independently operable. Rotation of a rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers. Such independent operation of the female couplers is achieved by rotating cams that are configured such that when one of the cams rotates to interact against its respective female coupler, the other of the cams does not act on its respective female coupler. Pressure relief valves are operated such that internal pressure within a female coupler is released prior to the female coupler reaching the release position during a disconnection operation.  
(Continued)



September 16, 2022

# CLAIM 1

1. A multi-coupling assembly comprising:

**a housing;**

**a first female coupler and a second female coupler** that are housed within the housing;

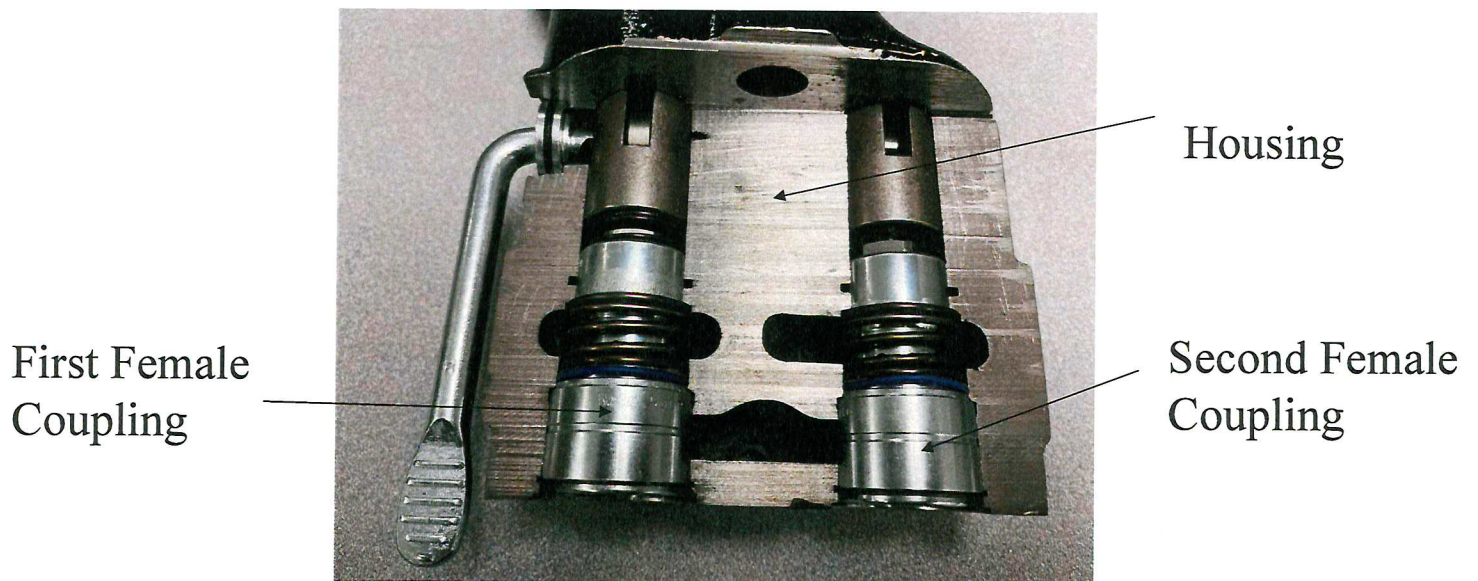
wherein each of the first female coupler and the second female coupler are moveable between **a coupling position** in which a female coupler is connectable to **a respective male coupler** to permit a flow of fluid through the multi-coupling assembly, and **a release position** in which the male coupler is releasable from **a respective female coupler;**

**a rotational lever** having **a handle portion** that is external from the housing and **a shaft portion** that extends from the handle portion into the housing, wherein rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers; and

**a first cam** located on the shaft portion of the rotational lever adjacent to the first female coupler, and **a second cam** located on the shaft portion of the rotational lever adjacent to the second female coupler; wherein rotation of the rotational lever rotates the first cam to interact against the first female coupler to move the first female coupler from the coupling position to the release position, and rotates the second cam to interact against the second female coupler to move the second female coupler from the coupling position to the release position; wherein the cams are configured such that rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers; and **wherein an axis of rotation of the rotational lever is perpendicular to an axis of the first and second female couplers, and the axis of rotation of the rotational lever extends parallel to, or in line with, a plane created by the two axes of the first and second female couplers.**



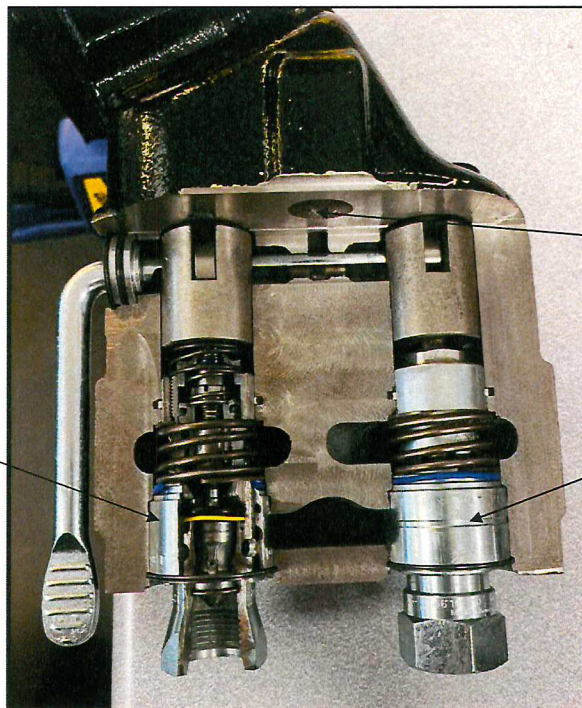
**CLAIM 1. A HOUSING;  
A FIRST FEMALE COUPLER AND A SECOND FEMALE  
COUPLER THAT ARE HOUSED WITHIN THE HOUSING;**





**WHEREIN EACH OF THE FIRST FEMALE COUPLER AND THE SECOND FEMALE COUPLER ARE MOVEABLE BETWEEN A COUPLING POSITION IN WHICH A FEMALE COUPLER IS CONNECTABLE TO A RESPECTIVE MALE COUPLER TO PERMIT A FLOW OF FLUID THROUGH THE MULTI-COUPLING ASSEMBLY**

First Female Coupling



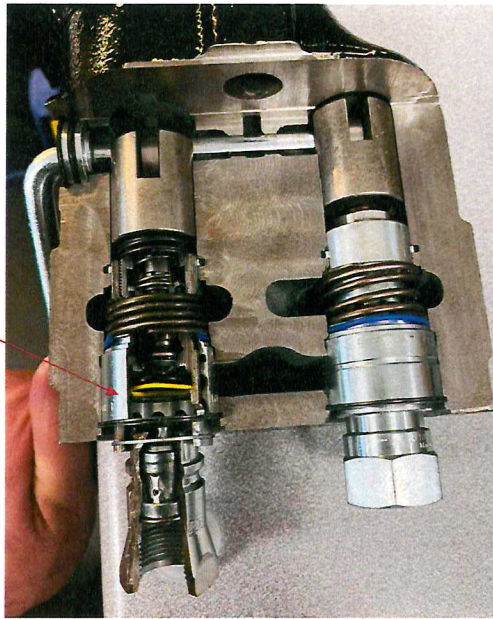
Flow path through the multi-coupling assembly

Second Female Coupling

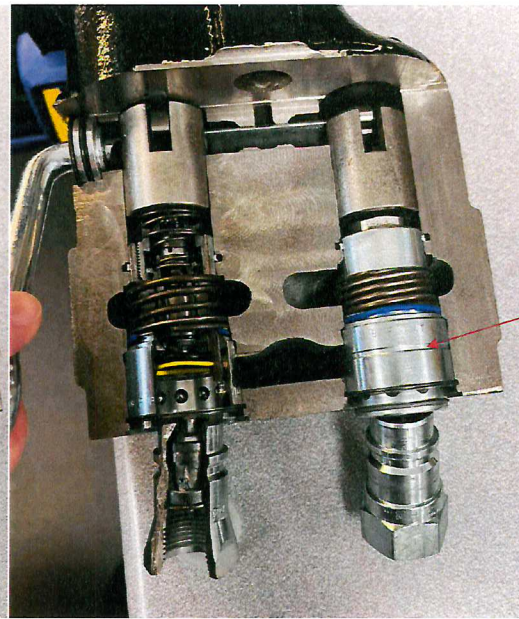


**AND A RELEASE POSITION IN WHICH THE MALE COUPLER IS  
RELEASABLE FROM A RESPECTIVE FEMALE COUPLER;**

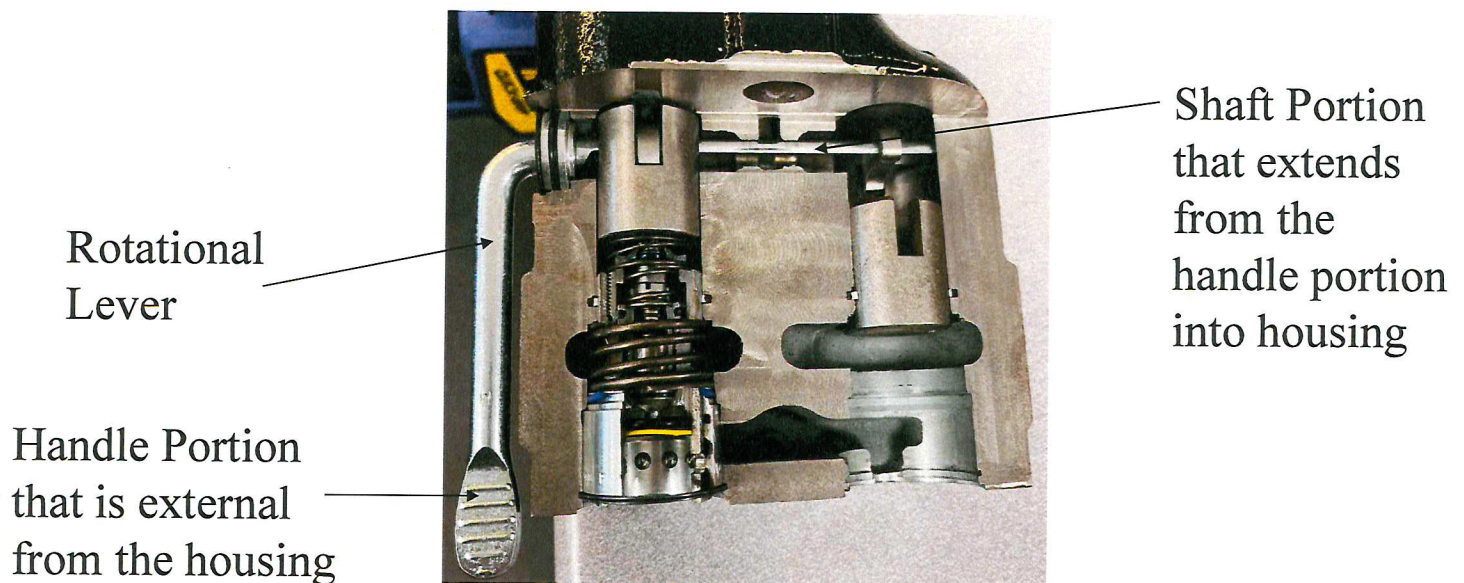
Release  
first  
female  
coupling



Release  
second  
female  
coupling



**A ROTATIONAL LEVER HAVING A HANDLE PORTION THAT IS EXTERNAL FROM THE HOUSING AND A SHAFT PORTION THAT EXTENDS FROM THE HANDLE PORTION INTO THE HOUSING**

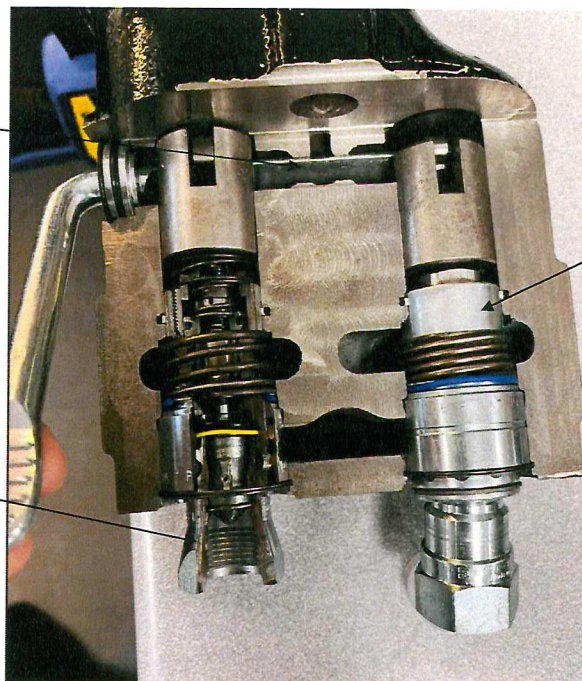




**WHEREIN ROTATION OF THE ROTATIONAL LEVER MOVES ONE OF THE FEMALE COUPLERS FROM THE COUPLING POSITION TO THE RELEASE POSITION WITHOUT AFFECTING A CONNECTION STATE OF THE OTHER OF THE FEMALE COUPLERS;**

Rotation of the rotational lever

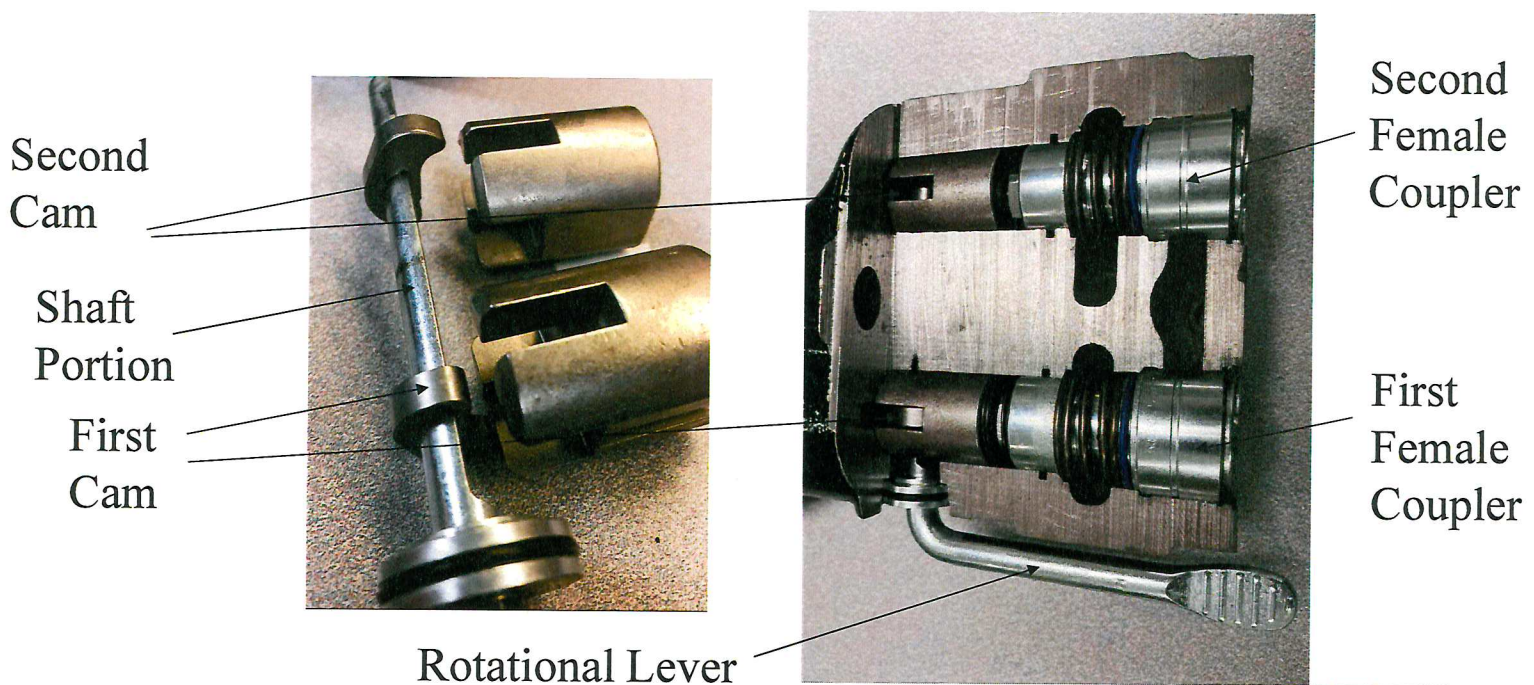
Connection state of the other female not affected



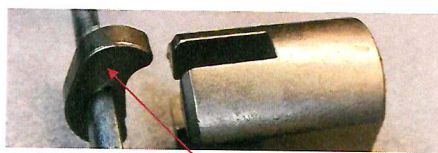
Moves one of the females from the coupling to the release position



**A FIRST CAM LOCATED ON THE SHAFT PORTION OF THE ROTATIONAL LEVER ADJACENT TO THE FIRST FEMALE COUPLER, AND A SECOND CAM LOCATED ON THE SHAFT PORTION OF THE ROTATIONAL LEVER ADJACENT TO THE SECOND FEMALE COUPLER;**



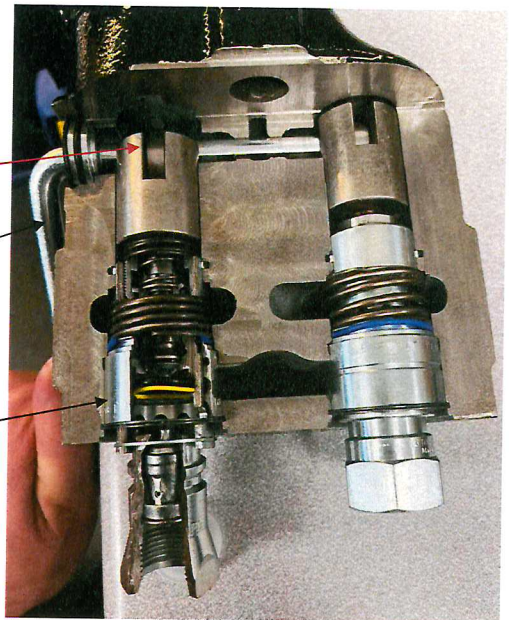
**WHEREIN ROTATION OF THE ROTATIONAL LEVER ROTATES THE FIRST CAM TO INTERACT AGAINST THE FIRST FEMALE COUPLER TO MOVE THE FIRST FEMALE COUPLER FROM THE COUPLING POSITION TO THE RELEASE POSITION**



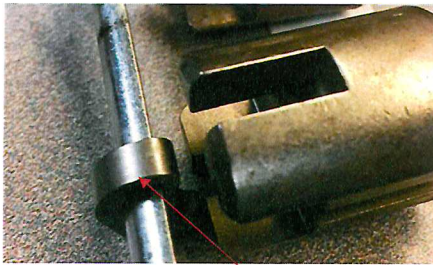
Cam

Rotational Lever

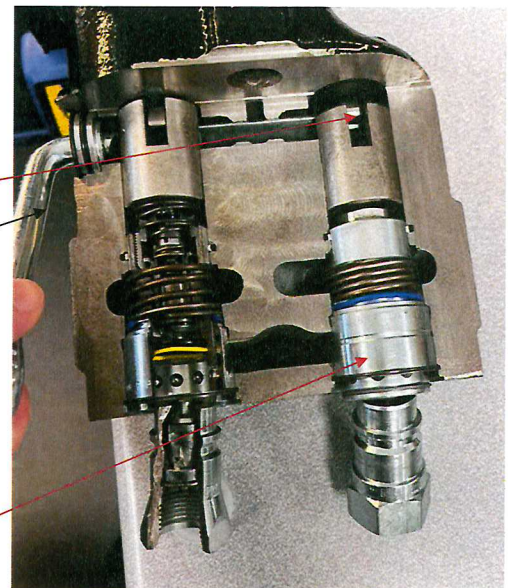
First Coupler



**AND ROTATES THE SECOND CAM TO INTERACT AGAINST THE SECOND FEMALE COUPLER TO MOVE THE SECOND FEMALE COUPLER FROM THE COUPLING POSITION TO THE RELEASE POSITION;**



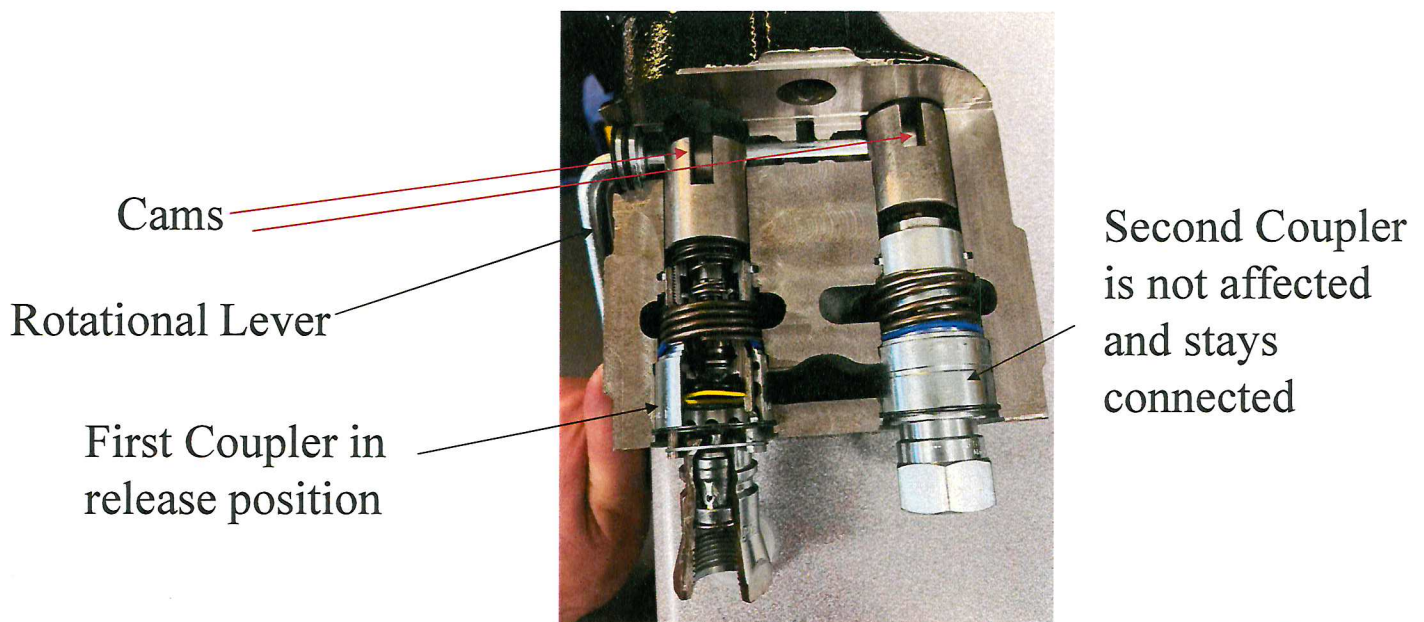
Cam  
Rotational Lever



Second Coupler

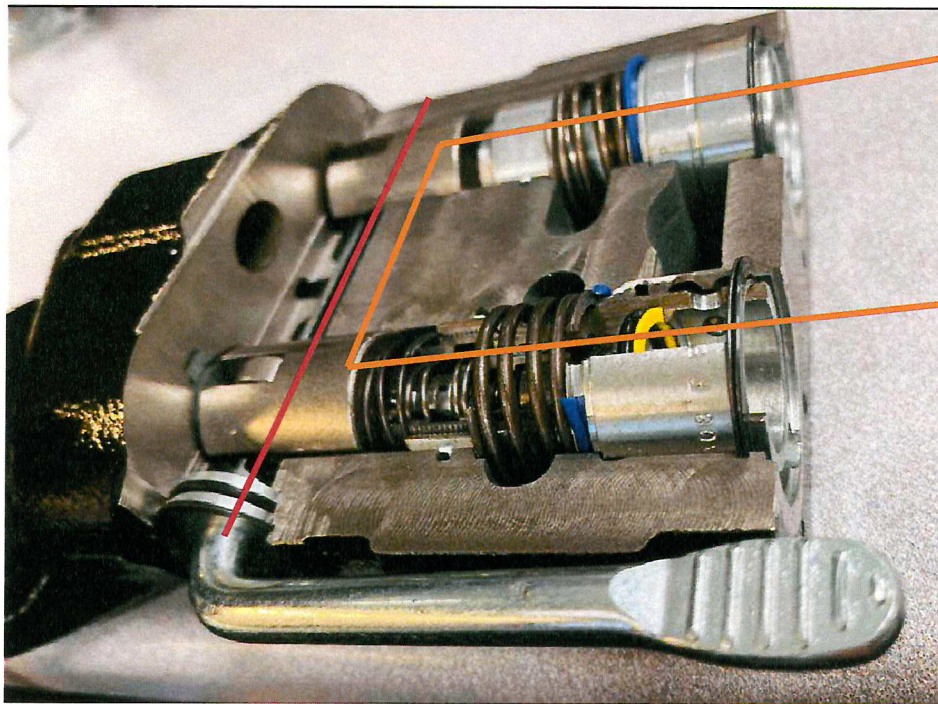


**WHEREIN THE CAMS ARE CONFIGURED SUCH THAT ROTATION OF THE ROTATIONAL LEVER MOVES ONE OF THE FEMALE COUPLERS FROM THE COUPLING POSITION TO THE RELEASE POSITION WITHOUT AFFECTING A CONNECTION STATE OF THE OTHER OF THE FEMALE COUPLERS;**



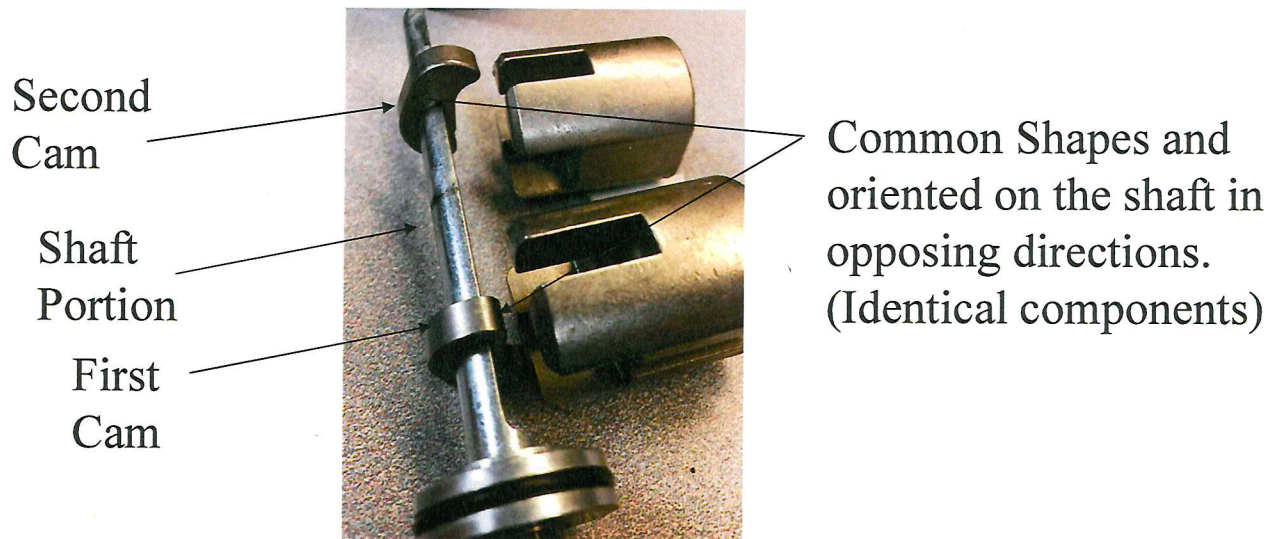


**WHEREIN AN AXIS OF ROTATION OF THE ROTATIONAL LEVER IS PERPENDICULAR TO AN AXIS OF THE FIRST AND SECOND FEMALE COUPLERS, AND THE AXIS OF ROTATION OF THE ROTATIONAL LEVER EXTENDS PARALLEL TO, OR IN LINE WITH, A PLANE CREATED BY THE TWO AXES OF THE FIRST AND SECOND FEMALE COUPLERS.**



## CLAIM 2

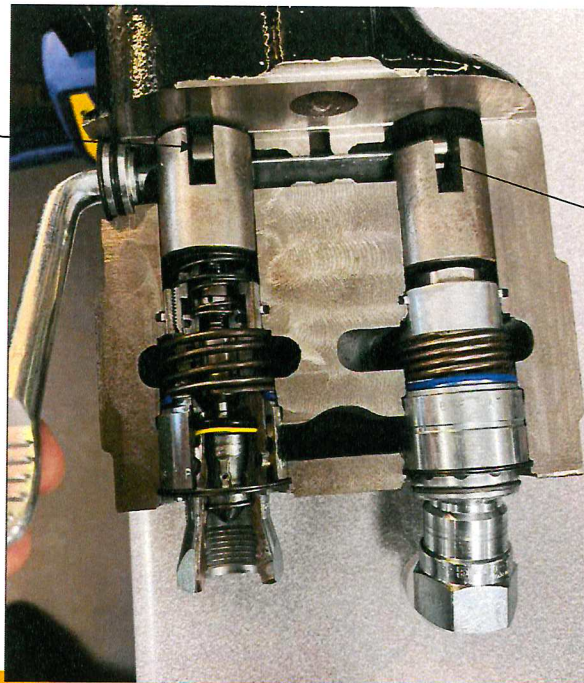
2. The multi-coupling assembly of claim 1, wherein the first cam and the second cam have a common shape and are oriented along the shaft portion of the rotational lever in opposing directions relative to each other.



# CLAIM 3

3. The multi-coupling assembly of claim 2, wherein when one of the cams rotates to interact against its respective female coupler, the other of the cams is positioned to not act against its respective female coupler by either not rotating or rotating away from its respective female coupler.

Other of the cams is positioned to not act. (Rotates away from its respective female coupler)

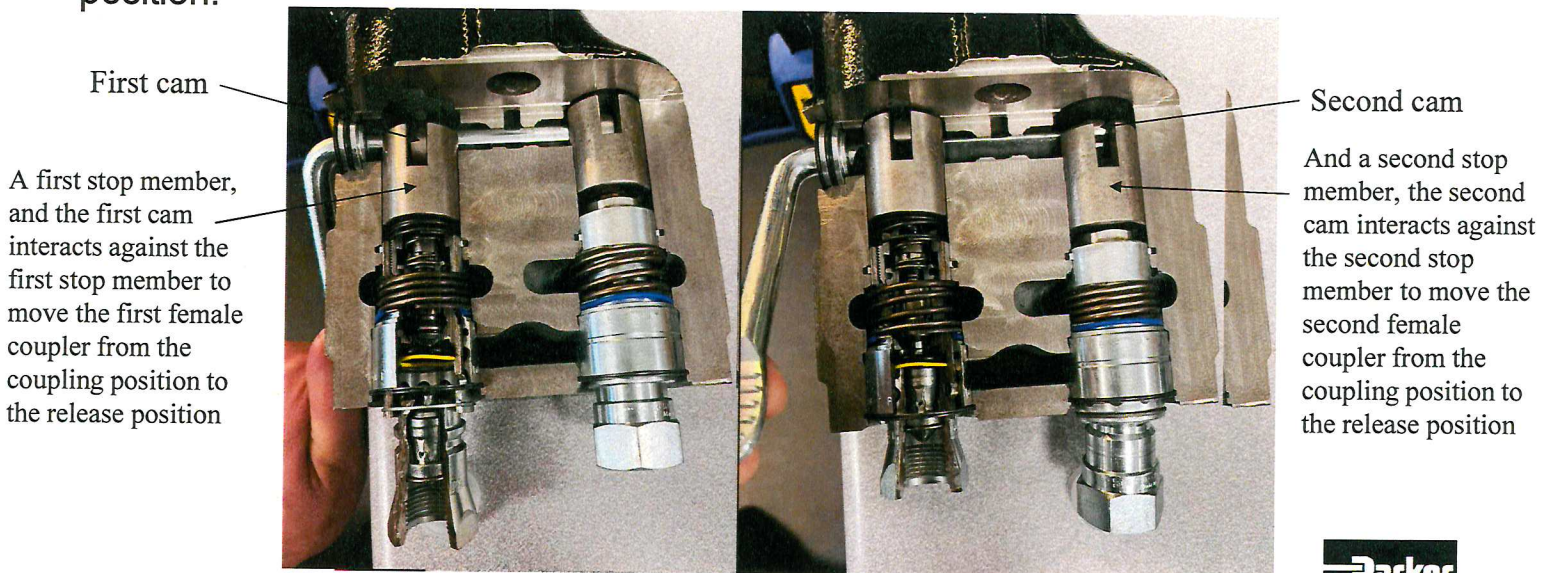


One of the cams rotates to interact against its respective female coupler



# CLAIM 4

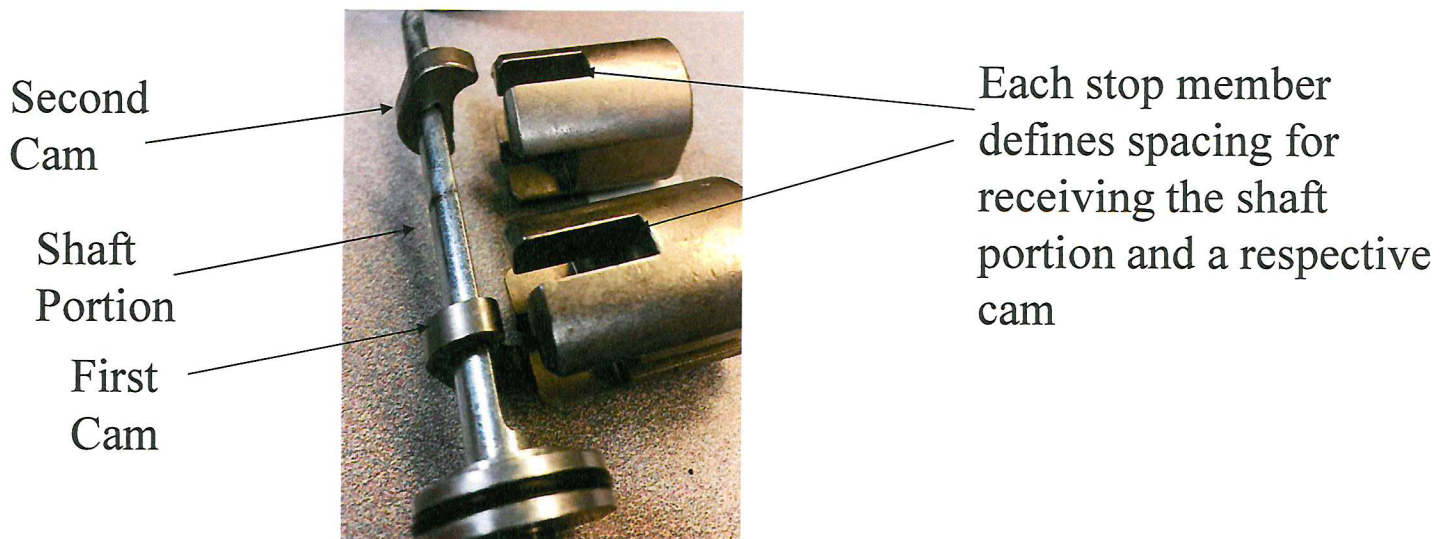
4. The multi-coupling assembly of claim 1, further comprising:  
a first stop member, and the first cam interacts against the first stop member to move the first female coupler from the coupling position to the release position; and  
a second stop member, and the second cam interacts against the second stop member to move the second female coupler from the coupling position to the release position.





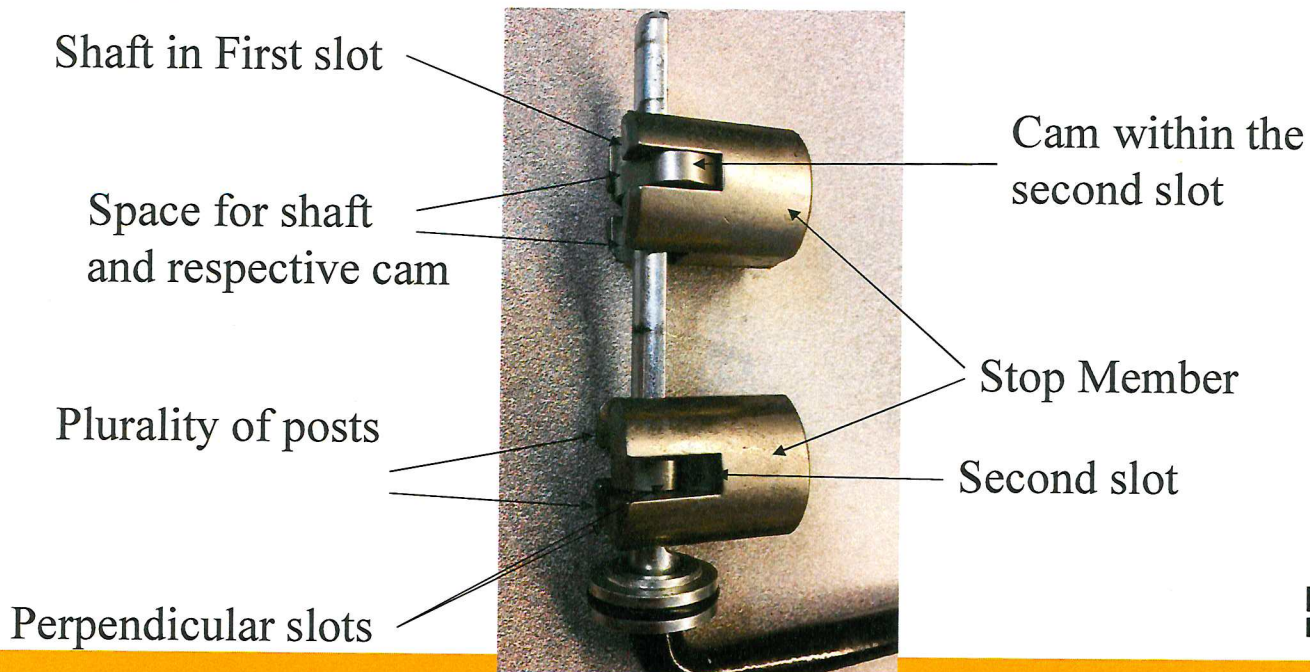
# CLAIM 5

5. The multi-coupling assembly of claim 4, wherein each stop member defines spacing for receiving the shaft portion of rotational lever and a respective cam.



# CLAIM 6

6. The multi-coupling assembly of claim 5, wherein each stop member comprises a plurality of posts and an inner surface that define first and second perpendicular intersecting slots, wherein the shaft portion of the rotational lever extends through the first slot and a respective cam is moveably located within the second slot.



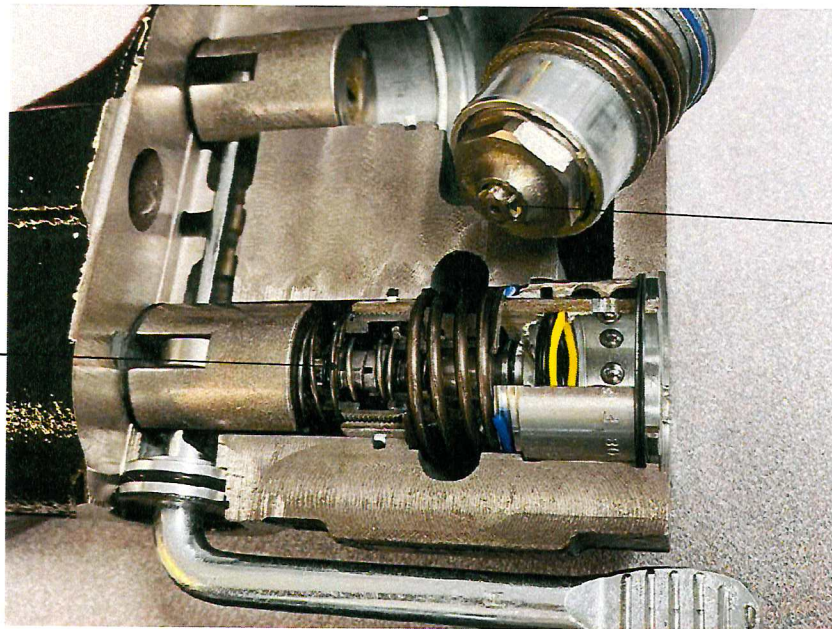
# CLAIM 7

7. The multi-coupling assembly of claim 4, wherein:

the first female coupler includes a first pressure relief valve, and the first stop member operates the first pressure relief valve when the first female coupler moves between the coupling position and the release position; and

the second female coupler includes a second pressure relief valve, and the second stop member operates the second pressure relief valve when the second female coupler moves between the coupling position and the release position.

First female coupler includes a first pressure relief valve, the first stop member operates the first pressure relief valve when the coupler moves between the coupling position and the release position. (See pictures in Claim 4)



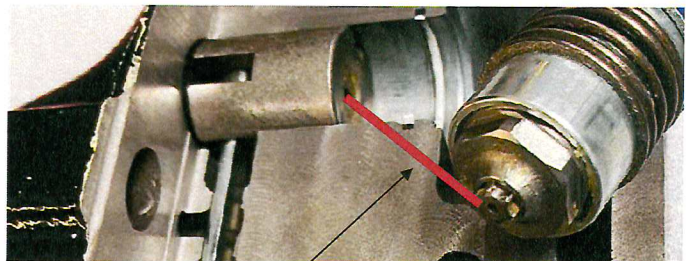
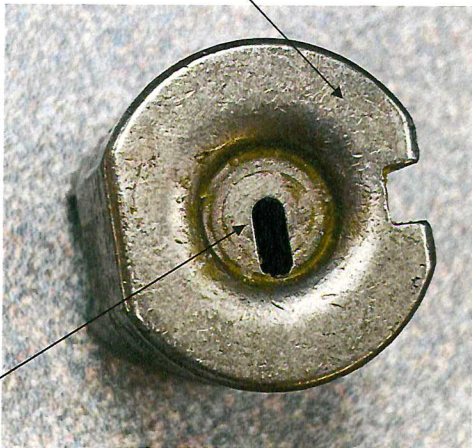
Second female coupler includes a second pressure relief valve, the second stop member operates the second pressure relief valve when the coupler moves between the coupling position and the release position. (See pictures in Claim 4)



# CLAIM 8

8. The multi-coupling assembly of claim 7, wherein each stop member includes a coupler interaction surface that includes a pressure release feature that operates a respective pressure relief valve.

Stop Member



Coupler interaction surface including a pressure release feature that operates a respective pressure relief valve

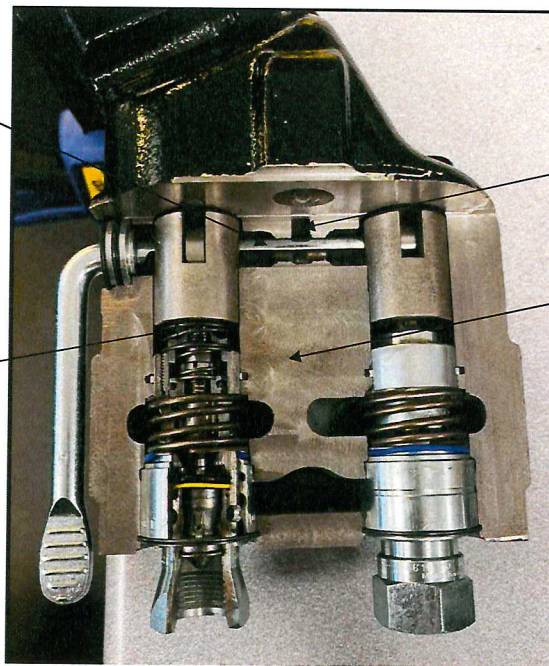


# CLAIM 9

9. The multi-coupling assembly of claim 7, wherein the housing defines a sump chamber through which the shaft portion of the rotational lever extends, and operation of the pressure relief valves releases internal pressure of a respective female coupler into the sump chamber.

Shaft portion of lever extends into the sump chamber

Operation of the pressure relief valve releases internal pressure of a respective female coupler into the sump chamber

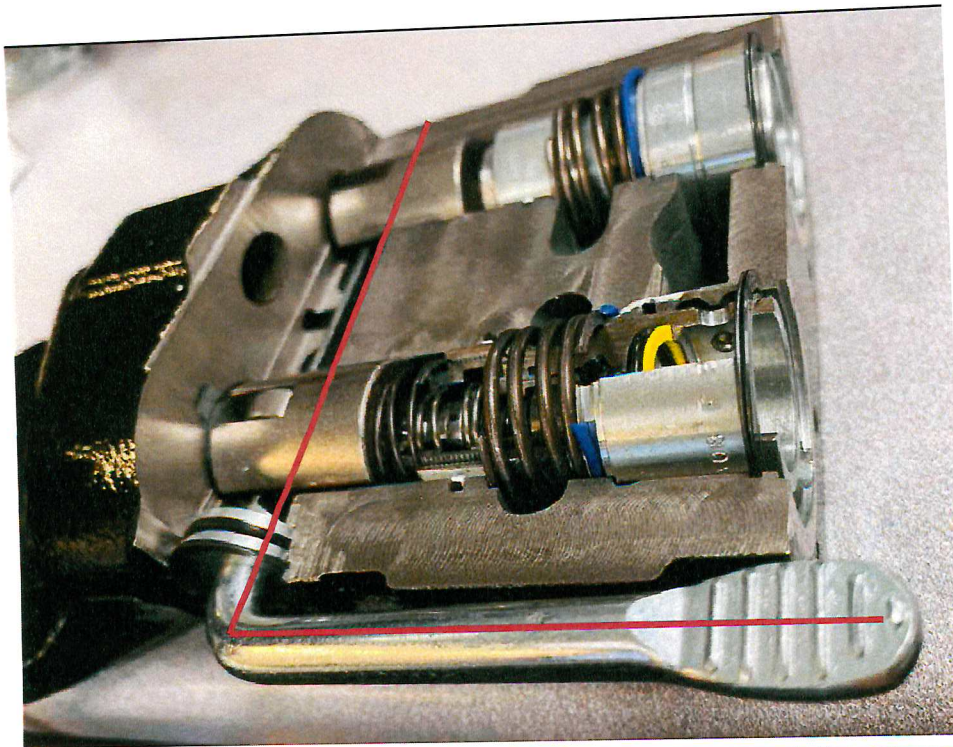


Sump chamber

Housing

# CLAIM 10

10. The multi-coupling assembly of claim 1, wherein the shaft portion of the rotational lever extends substantially perpendicularly from the handle portion.





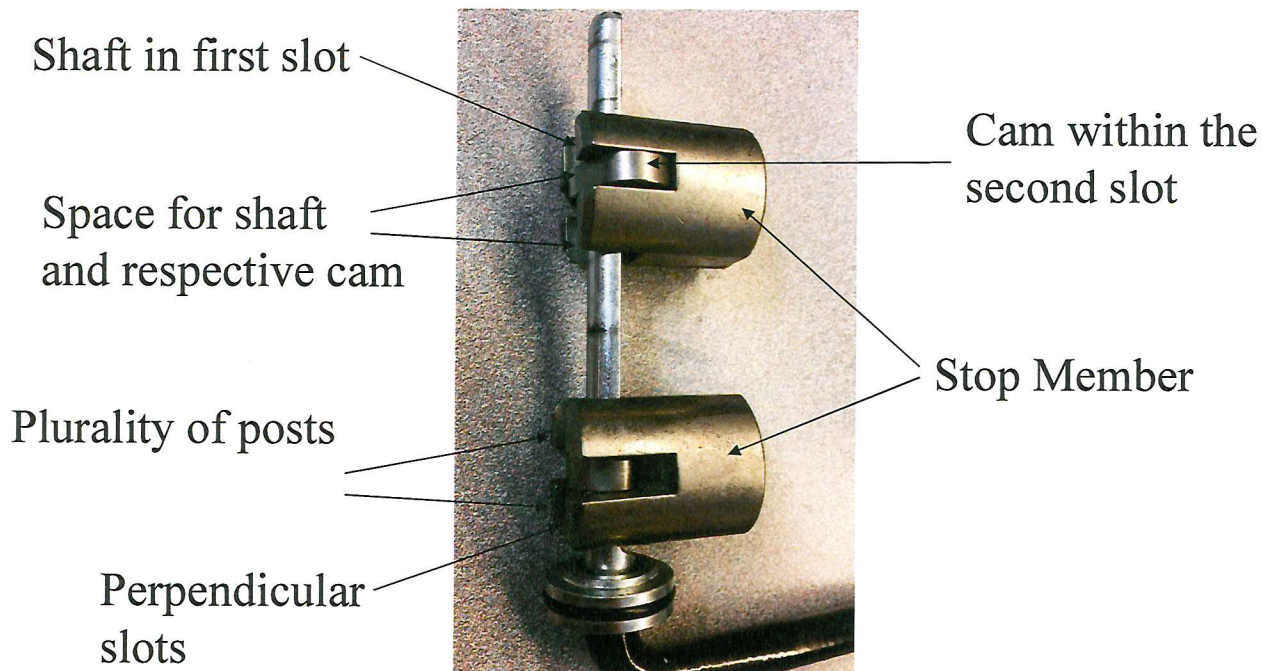
# CLAIM 11

11. A multi-coupling assembly comprising:  
a housing;

a first female coupler and a second female coupler that are housed within the housing; wherein each of the first female coupler and the second female coupler is moveable between a coupling position in which one of the female couplers is connectable to a respective male coupler to permit a flow of fluid through the multi-coupling assembly, and a release position in which the male coupler is releasable from the female coupler; a rotational lever having a handle portion that is external from the housing and a shaft portion that extends from the handle portion into the housing, wherein rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers; a first cam located on the shaft portion of the rotational lever adjacent to the first female coupler, and a second cam located on the shaft portion of the rotational lever adjacent to the second female coupler; a first stop member, and the first cam interacts against the first stop member to move the first female coupler from the coupling position to the release position, and a second stop member, and the second cam interacts against the second stop member to move the second female coupler from the coupling position to the release position; **wherein each stop member defines spacing for receiving the shaft portion of rotational lever and a respective cam; wherein each stop member comprises a plurality of posts and an inner surface that define first and second perpendicular intersecting slots, wherein the shaft portion of the rotational lever extends through the first slot and a respective cam is moveably located within the second slot;** wherein rotation of the rotational lever rotates the first cam to interact against the first female coupler to move the first female coupler from the coupling position to the release position, and rotates the second cam to interact against the second female coupler to move the second female coupler from the coupling position to the release position; and wherein the first and second cams are configured such that rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers.



**CLAIM 11.** wherein each stop member defines spacing for receiving the shaft portion of rotational lever and a respective cam; wherein each stop member comprises a plurality of posts and an inner surface that define first and second perpendicular intersecting slots, wherein the shaft portion of the rotational lever extends through the first slot and a respective cam is moveably located within the second slot



# CLAIM 12

12. A multi-coupling assembly comprising:

**a housing;**

**a first female coupler and a second female coupler** that are housed within the housing; wherein each of the first female coupler and the second female coupler is moveable between **a coupling position** in which one of the female couplers is connectable to a respective male coupler to permit a flow of fluid through the multi-coupling assembly, and **a release position** in which the male coupler is releasable from the female coupler;

**a rotational lever having a handle portion** that is external from the housing and **a shaft portion** that extends from the handle portion into the housing, wherein rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers;

**a first cam** located on the shaft portion of the rotational lever adjacent to the first female coupler, and **a second cam** located on the shaft portion of the rotational lever adjacent to the second female coupler; wherein rotation of the rotational lever rotates the first cam to interact against the first female coupler to move the first female coupler from the coupling position to the release position, and rotates the second cam to interact against the second female coupler to move the second female coupler from the coupling position to the release position; and

wherein the cams are configured such that rotation of the rotational lever moves one of the female couplers from the coupling position to the release position without affecting a connection state of the other of the female couplers, **such that when one of the first or second cams rotates to interact against its respective female coupler, the other of the first or second cams is positioned to not act to move its respective female coupler by rotating away from its respective female coupler.**



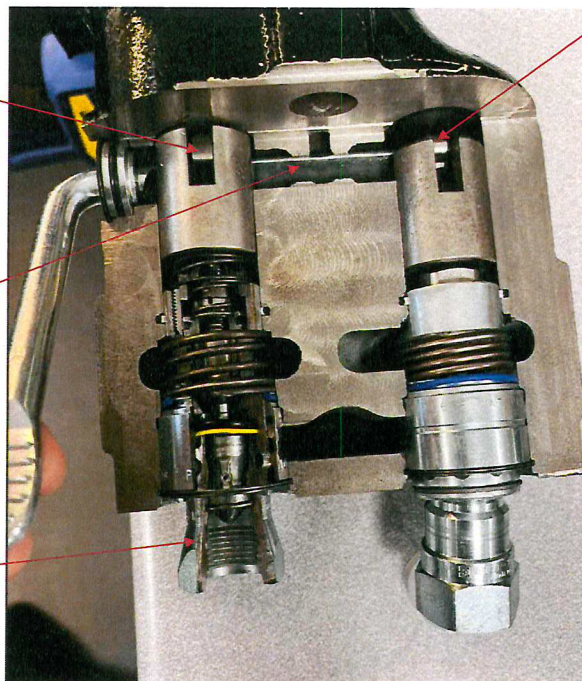


**CLAIM 12. SUCH THAT WHEN ONE OF THE FIRST OR SECOND CAMS ROTATES TO INTERACT AGAINST ITS RESPECTIVE FEMALE COUPLER, THE OTHER OF THE FIRST OR SECOND CAMS IS POSITIONED TO NOT ACT TO MOVE ITS RESPECTIVE FEMALE COUPLER BY ROTATING AWAY FROM ITS RESPECTIVE FEMALE COUPLER**

Other cam does not act by rotating away from its respective female coupler

Rotation of the rotational lever

Connection state of the other female not affected



Cam rotates to interact against the female.

Before rotation

